

TITLE OF THE INVENTION

COATINGS FOR INKJET MEDIA

BACKGROUND OF THE INVENTION

5 Field of the Invention

The invention relates to coatings for inkjet media such as, for example, paper, films and textiles, and their use in the production and finishing of inkjet media.

Discussion of the Background

10 Inkjet media are media used for printing with inkjet printers. In the paper industry, fillers are required which, for example, absorb the ink well in inkjet media and maintain the brilliance of the colors. In order to increase the printing speed and reduce the print dot size in inkjet printing, rapid drying is indispensable.

15 In the paper and films industry, attempts have been made for some time to formulate water-resistant inkjet media and therefore to protect them by variations in, for example, the binders, or to make the media hydrophobic and fix the color by subsequent application of a film, coating or lamination.

The known results of the above attempts have the following disadvantages:

- They are cost-intensive.
- An additional production step is necessary.
- 20 - Intensive development work is necessary in the preliminary field.
- The brush-on paints must be formulated with additional components, such as cationic additives.
- The inks are not adequately fixed.

25 Accordingly, the need still remains for brush-on paints for inkjet media which avoid the aforementioned problems associated with conventional applications.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide coatings for inkjet media.

It is another object of the present invention to provide coatings for inkjet media which

increase the water-resistance of the media.

It is another object of the present invention to provide coatings for inkjet media which allow better fixing of the anionic inks.

It is another object of the present invention to provide coatings for inkjet media which show an increase in the print quality.

It is another object of the present invention to provide coatings for inkjet media which have the effect of fixing of the inks/dyestuffs in the upper brushed-on layer.

It is another object of the present invention to provide coatings for inkjet media which show a reduction in bleeding.

It is another object of the present invention to provide coatings for inkjet media which have a combination of additive properties and pigment properties.

These objects and others may be accomplished with the present invention, the first embodiment of which provides a coating for inkjet media, which includes:

- at least one hydrophobic filler; and
- a binder.

Another embodiment of the invention provides an inkjet media, which includes the above-described coating coated on a substrate.

Another embodiment of the invention provides a method of inkjet printing, which includes inkjet printing at least one inkjet ink onto a substrate coated with the above-described coating.

Another embodiment of the invention provides a coating composition, which includes:

a hydrophobic filler that includes at least one filler particle and a means for making the particle hydrophobic; and

a means for binding said hydrophobic filler.

Another embodiment of the invention provides an inkjet media, which includes:

(a) a coating composition, which includes:

(i) a hydrophobic filler which includes at least one filler particle and a means for making the particle hydrophobic, and

(ii) a means for binding said hydrophobic filler; and

(b) a means for supporting the coating composition in contact with the coating composition.

Another embodiment of the invention provides a method for inkjet printing, which includes a step for inkjet printing onto an inkjet media, which includes:

(a) a coating composition, which includes:

(i) a hydrophobic filler which includes at least one filler particle and a means
5 for making the particle hydrophobic, and

(ii) a means for binding said hydrophobic filler; and

(b) a means for supporting the coating composition in contact with the coating composition.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

10 Various other objects, features and attendant advantages of the present invention will be more fully appreciated as the same becomes better understood from the following detailed description of the preferred embodiments of the invention.

Preferably, the coating is in the form of a brush-on paint. The coating may be preferably applied to a substrate, if desired, by brushing on, spraying, doctor blading, or any
15 other known method for coating substrates.

The invention provides coatings for inkjet media, which are characterized in that they include a binder and at least one hydrophobic filler. Preferably, the hydrophobic fillers are surface treated such that they are hydrophobic. Preferable fillers include silicas such as colloidal silica, silica gel, precipitated silica, pyrogenic silica; silicates such as calcium
20 silicate, aluminum silicate, sodium aluminum silicate, aluminum polysilicate; naturally occurring and/or synthetic pigments such as aluminum oxide, clays, bentonite, calcined clay, precipitated calcium carbonate, mica, montmorillonite, kaolinite, asbestos, talc, diatomaceous earth, vermiculite, natural and synthetic zeolites, cement, alumina silica gels and glass. Combinations of fillers are possible.

25 More preferably, the filler is selected from the group including silicas such as colloidal silica, silica gel, precipitated silica, pyrogenic silica and silicates such as calcium silicate, aluminum silicate, sodium aluminum silicate and aluminum polysilicate.

More particularly preferably, the filler is selected from the group including silicas such as colloidal silica, silica gel, precipitated silica and pyrogenic silica.

30 Most preferably, the filler is selected from the group including precipitated silica and pyrogenic silica.

Preferably, surface-treated silicas, such as, for example, cationized and silanized silicas, can be employed.

Preferably, the hydrophobic filler is selected from the group including surface-treated silica, cationized silica, and silanized silica, and combinations thereof. The term,
5 "cationized" means hydrophobic silica obtained by coating with silicon oil which preferably contains cationic groups such as quaternary ammonium groups.

Preferably, the hydrophobic filler has a carbon content of 0.1 to 5% by weight, based on the weight of the hydrophobic filler, and more preferably 0.5 to 2.5% by weight. These ranges include all values and subranges therebetween, including 0.2, 0.3, 0.4, 0.6, 0.7, 0.8,
10 0.9, 1, 2, 3, 4 and 4.5 % by weight, based on the total weight of the hydrophobic filler.

Preferably, the hydrophobic filler has a DBP uptake of 50-350 g/100 g and more preferably 150-280 g/100 g. These ranges include all values and subranges therebetween, including 55, 75, 100, 125, 175, 225, 250, 275, 300 and 325 g/100 g.

Preferably, the hydrophobic filler has a surface area of 50-800 m²/g and more preferably 150-700 m²/g. These ranges include all values and subranges therebetween, including 75, 100, 200, 300, 400, 500, 600 and 675 m²/g.
15

Preferably, the hydrophobic filler has a particle size of less than 15 μm, more preferably 5-12 μm, and most preferably (for pyrogenic silicas) 2-200 nm. In the case of pyrogenic silicas, these figures relate to the primary particle size. These ranges include all values and subranges therebetween, including 4, 10, 25, 50, 75, 100, 125, and 175 nm, and 1,
20 2, 3, 4, 6, 7, 8, 9, 10 and 11 μm.

The filler may be a precipitated silica which has been treated with a water-repellent agent after its production and/or also during its production.

Precipitated silicas are known from Ullmanns Enzyklopädie der technischen Chemie,
25 4th edition, volume 21, pages 458 to 473 (1988), the entire contents of which is hereby incorporated by reference.

The production of fully hydrophobic silicas is, for example, known from DE 44 19 234 A1, DE-C 27 29 244, DE 26 28 975 C2 and DE-OS 21 07 082, the relevant contents of which are hereby incorporated by reference. DE 26 28 975 C2 and DE-C 27 29 244 relate to
30 fully hydrophobic precipitated silicas. The two other patent specifications or unexamined German publications relate to fully hydrophobic and partially hydrophobic pyrogenic silicas. Other preferred hydrophobic precipitated silicas are described in, e.g., U.S. 6,191,122, the

entire contents of which are hereby incorporated by reference.

In a preferred embodiment, the hydrophobic precipitated silica useful for the invention can include 85 to 98 % by weight of precipitated silica and 15 to 2 % by weight of surface treatment agent (preferably silicon oil having a carbon content of 32.4 %). To obtain the desired degree of water-repellence, it can be prepared by mixing the requisite amount of water-repellent agent using high shearing forces with precipitated silica suspension prepared using a known process according to a given ratio with very short residence time and low pH value, filtering off the water-repellent agent-containing precipitated silica suspension and washing this free of salt, drying the precipitated silica filter cake homogeneously mixed with water-repellent agent using a known process, providing thermic post-treatment or tempering and then carrying out mechanical or radiation milling.

It is preferable to mix silicon oil homogeneously using high shearing energy with a precipitated silica suspension produced using known processes, with or without addition of phase transmitters (e.g. wetting agents, emulsifiers).

The continuous shearing device is preferably an Ultra-Turrax, a Kothoff-Mischsirene or a Rheinhütte mixer. The precipitated silica suspension homogeneously mixed with water-repellent agent is preferably then separated using known filtration apparatuses (e.g. chamber filtration press, rotary filter) and the solid matter containing water-repellent agent is washed free of salt. In so doing, the water-repellent agent is entirely taken up by the precipitated silica filter cake. The filtrates yielded are no longer contaminated with organosilicon compounds, with the result that the measured TOC contents are < 10 mg/l.

Especially preferred embodiments of the precipitated silica suspensions used to prepare the hydrophobic silicas in the coating include precipitated silicas A and B below, and are characterized by the following respective physical chemical material data:

Precipitated silica A (the substance data relate to a filtered, washed and dried precipitated silica sample, without added water-repellent agent):

BET surface according to DIN 66131	150±50 [m ² /g]
Mean size of primary particles from EM photos	15-25 [nm]
Loss on drying according to DIN 55921	2.5-4.5 [%]
after 2 h at 105°C	
Loss at red heat (related to the substance	3±0.5 [%]
dried for 2 h at 105°C according to DIN 55921)	

	pH value (in 5% aqueous dispersion according to DIN 53200)	3.5-6.5
	Conductivity (in 4% aqueous dispersion)	< 1000 [μ S]
	SO ₃ content (related to the substance dried for 2h at 105°C according to DIN 55921)	0.3 [%]
5	Na ₂ O content (related to the substance dried for 2h at 105°C according to DIN 55921)	0.3 [%]
	Precipitated silica B (the substance data relate to a filtered, crushed and dried precipitated silica, without added water-repellent agent):	
10	BET surface according to DIN 66131	300±50 [m ² /g]
	Mean size of primary particles from EM photos	10-15 [nm]
	Loss on drying according to DIN 55921 after 2 h at 105°C	2.5-4.5 [%]
	Loss at red heat (related to the substance dried for 2h at 105°C according to DIN 55921)	3±0.5 [%]
15	pH value (in 5% aqueous dispersion according to DIN 53200)	3.5-6.5
	Conductivity (in 4 % aqueous dispersion)	< 1000 [μ S]
	SO ₃ content (related to the substance dried for 2h at 105°C according to DIN 55921)	< 0.3 [%]
20	Na ₂ O content (related to the substance dried for 2h at 105°C according to DIN 55921)	< 0.3[%]
	For hydrophobizing it is preferable to use silicon oil, which includes dimethylpolysiloxanes with a viscosity of 20 to 1000 mPas, preferably with 50 mPas as	
25	water-repellent agents. It is also preferable to use one or more of the following: R ₂ R'Si-, where R=CH ₃ O-, C ₂ H ₅ O-, Cl-, R'=CH ₃ -, C ₂ H ₅ -, HMDS (hexamethyl disilazane), octamethyl tetrasiloxane, D6, D8, R ₃ Si-C _n H _{2n+1} , where n=1-18, R=CH ₃ O-, C ₂ H ₅ O-, C ₃ H ₇ -O-, Cl-, more preferably trimethoxyoctylsilane, Si 116, polymethyl siloxanes, polymethyl siloxane emulsions, (trimethyloxyhexadecyl silane), aminopropyl silanes, vinyl silanes, methacrylic	
30	silanes. Combinations are possible.	
	The resultant precipitated silica filter cake homogeneously mixed with water-repellent agent is dried in the subsequent process step in known drying aggregates. The drying	

aggregate for drying the water-repellent agent-containing filter cake can be a band dryer or spin-flash dryer. To achieve the desired degree of water-repellence, the dry product containing water-repellent agent is subjected to thermic post-treatment at 300°C to 400°C, preferably 350°C for 30 to 60 minutes in a discontinuous, electrically heated stirrer container or in a continuous electrically heated double screw reactor thermally treated or tempered and then milled mechanically or using jet mills.

Another preferred embodiment for preparing the hydrophobic precipitated silica in the coating of the invention includes the following process of wet water-repellence.

A mass stream of 0.424 kg/h polymethyl siloxane is added using a continuous mixer with high shearing energy input to a mass stream of 160 kg/h of an aqueous precipitated silica suspension with a solids content of 85 g/l, that was prepared using known manufacturing processes, while maintaining a pH value of 3, the temperature of the two components to be mixed being $25 \pm 5^\circ\text{C}$. In so doing, the residence time in the mixer may not exceed 5 seconds. The command reference input for the coating process is taken to be the dimensionless coating index B_i which describes the ratio to one another of the active substance portions of the two mass streams to be mixed. A coating index of 32 is needed to achieve the hydrophobic property of the precipitated silica of the invention.

Preferably, the precipitated silica coated with silicone oil is then separated using known processes without using a subsequent post-reaction time, washed almost free of electrolyte, dried at 105°C, tempered for 1.0 hour at 370°C and then milled.

Preferably, the filler in the coating of the invention can be prepared in the mixer due in particular to the low pH value and the short residence time in the mixer.

The term, "hydrophobic" is well-known to those of skill in the art to which the invention pertains. Preferably, the hydrophobicity of the fillers in accordance with the invention may be defined by the carbon content of the silicon-coated filler or by methanol wettability.

Fillers, the surfaces of which are modified with non-hydrolyzable and/or ionic organic groups, are generally not wetted with water. These hydrophobic fillers can, however, be wetted using a methanol/water mixture. The proportion of methanol in this mixture - expressed in percent by weight - is a measure of the water-repellence of the modified filler. The higher the proportion of methanol, the more hydrophobic is the substance. Methods for determining the methanol wettability are known and described in, e.g., U.S. 6,191,122, the

entire contents of which are hereby incorporated by reference.

Preferably, the methanol wettability of the hydrophobic fillers (and more preferably hydrophobic silicas) used in the present invention is 10-80%, and more preferably 10-49%. These ranges include all values and subranges therebetween, including 15, 20, 25, 30, 35, 40,
5 45, 50, 55, 60, 65, 70 and 75%.

The dibutylphthalate number (DBP number) is determined using a Brabender plastograph. The DBP number is a measure of the liquid absorbency or absorption capacity of a product in powder form. Absorption capacity depends on moisture content, on granulation and initial weight of the material investigated. In the present case, DBP number
10 is a measure of the absorbency of the filler. DBP number is well-known to those in the art, and methods for determining DBP number are known and described in, e.g., U.S. 6,191,122, already incorporated by reference.

Methods of determining the particle size of the silica are known and described, e.g., in U.S. 6,191,122, already incorporated by reference.

Preferably, the coatings according to the invention have a solids content of between 2
15 and 40%, more preferably between 5 and 30%, and most preferably between 10 and 20%, which ranges include all values and subranges therebetween, including 3, 4, 9, 12, 14, 25 32 and 35.

Preferably, the coatings according to the present invention may be prepared by
20 combining the filler with a binder, and more preferably with a solution of a water-soluble or water-dispersible polymer as binder. Other preferred binder polymers include polyamide, polyethylenimine, polyacrylamide, cationic-modified polyvinyl alcohol, polyvinyl alcohol, polyvinyl pyridine, amino-substituted polyacrylate, amino-substituted polyether, amino-substituted polyester, polyvinylpyrrolidone, vinyl acetate, poly(m)ethacrylate,
25 copolymers thereof, and combinations thereof. Most preferably, the binder is selected from the group including polyvinyl alcohol, polyvinylpyrrolidone, vinyl acetate, starch, cellulose, latex, copolymers thereof, and combinations thereof. Most especially preferably, the binder is selected from the group including polyvinyl alcohol, polyvinylpyrrolidone/vinyl acetate copolymer, and combinations thereof.

30 The method of preparing the coating is not particularly limited. Preferably, the hydrophobic filler is wetted or dispersed in either an aqueous solution, a mixture of one or more alcohols and water, or one or more alcohols, and the resulting solution or dispersion is

combined with a solution or dispersion of the binder. Preferably, a mixture of alcohol and water is used for wetting or dispersing the hydrophobic filler. Preferably, ethanol or methanol is used in such a mixture. The thus obtained coating mixture is applied to a substrate and allowed to dry.

5 Preferably, the binder is present in the coating in an amount ranging from 10-90 parts by weight, based on 100 parts by weight of the dried coating. More preferably, the binder is present in an amount ranging from 20-80 parts by weight, more especially preferably 25-70 parts by weight, and most preferably 30-50 parts by weight. These ranges include all values and subranges therebetween, including 15, 22, 33, 35, 45, 55, 65, 75 and 85 parts by weight.

10 Another preferred embodiment of the invention provides an ink-jet media, which includes the coating in contact with a support. Preferred supports include plain paper, resin coated paper, cloth, wood, metal plates, films or sheets of polyester resins, diacetate resins, triacetate resins, acrylic resins, polycarbonate resins, polyvinyl chloride resins, polyimide resins. The support may be either transparent or opaque.

15 The ink for the inkjet printing is not particularly limited, and may be either a pigment-containing ink or a dye-containing ink. The ink may contain either an organic or aqueous solvent or a mixture of both.

Preferably, the support has a thickness of 50 to 500 μm , more preferably 75 to 300 μm .

20 The coatings according to the invention for inkjet media have the following advantages:

- Increase in the water resistance
- Increase in the fixing of the ink
- Increase in the print quality
- 25 - Fixing of the inks in the upper brushed-on layers
- Combination of additive and pigment properties in one product
- Increase in the color intensity
- Increase in the point sharpness

30 The present invention thus allows for rapid uptake of the ink, improve the point sharpness and promote defined, circular spreading out of the ink drop. The present invention also prevents the ink from showing through or penetrating through, and it produces high color densities.

Compared with standard formulations, the coatings according to the invention, in particular those which include precipitated silicas, show advantages in the printed image, in particular in the point sharpness. They also have an improved water resistance.

EXAMPLES

Having generally described this invention, a further understanding can be obtained by reference to certain specific examples which are provided herein for purposes of illustration only and are not intended to be limiting unless otherwise specified.

Experimental procedure/method

Coatings based purely on silica with a solids content of 15% or also 20, 10 and 7% are formulated. The Brookfield viscosity is measured at 5, 10, 20, 50 and 100 rpm 7 days after preparation. The coatings prepared are brushed on to standard base paper, with subsequent drying and calendering of the paper specimens. The absorption properties of inkjet inks are measured according to test A, B and C and the print test is carried out by four-color and three-color printing by means of an HP Deskjet 550 C. The hydrophobic properties of the papers/prints are evaluated by means of the "water drop test".

The overall evaluation includes the ease of incorporation, the brushing properties, the adhesion of the coating, the absorption properties, the printability and the hydrophobic properties.

To prepare the inkjet coatings of the examples, in particular the standard recipe, 30 parts PVA are initially introduced into the total amount of water and are dissolved at 95°C. The silica or the silica mixture (precipitated and pyrogenic silica) is subsequently incorporated at 1000 rpm and then dispersed at 3000 rpm for 30 minutes.

For incorporation of the silicas according to examples 1-8 into the aqueous system, the dissolved binder (37 parts PVA / 3 parts PVP/VA) and the corresponding sample are introduced into a glass bottle and mixed with a Turbula mixer for ten minutes. The system is then transferred to a double-walled vessel and dispersed by means of a dissolver at 3000 rpm. The coatings formulated in this way include 100 parts silica, or silica mixture, and 37 parts polyvinyl alcohol (PVA), and 3 parts polyvinylpyrrolidone/vinyl acetate copolymer (PVP/VA), or 100 parts silica mixture and 30 parts PVA for the standard recipe.

Another possibility for the preparation of the coating includes wetting the silica

and/or the hydrophobized pigment by means of a mixture of methanol and water and then stirring this into the binder solution.

In the Examples, additives and co-binders are not added to the coatings as is usual. The coating in the Examples recipe has not been optimized further for highly water-resistant properties. Coating recipes for various media are described, inter alia, in Technical Information No. 1212 of Degussa-Hüls, Business Unit FP, the entire contents of which are hereby incorporated by reference. The use according to the invention of the partly or highly hydrophobic silicas can be applied to other recipes.

The specimen is brushed sheet-wise (DIN A4) by means of a Dow Coater at 50m/min. The papers dried in a Dow tunnel dryer are satinized at 9 bar/45°C by means of a calender and used for the following tests.

For test A

7.5 μ l of each printing ink are applied to the substrate by means of an Eppendorf Variopet and left to dry. The drying properties are evaluated analogously to the evaluation table and the diameter is measured in mm.

For test B

1 μ l of each printing ink is applied to the substrate by means of a Hamilton microlitre pipette. The drying properties and the penetration properties are evaluated analogously to the evaluation table and the time taken for drying is measured in seconds.

For test C

1 μ l of each printing ink is applied to the medium by means of a Hamilton microlitre pipette. One minute thereafter the drop is distorted with a scoop spatula held at an angle of approx. 45° and the length is measured in mm.

The values determined in this manner give information on the absorption properties.

The hydrophobic properties of the papers/prints are furthermore investigated with the aid of a "water drop test":

60 μ l portions of distilled water are introduced in each case on to an area printed in black and an area printed in color and left to act for 30 seconds. After careful dabbing off of the excess amount of water, the evaluation takes place. 60 μ l are furthermore introduced on to a non-printed area and the paper is rotated slowly and continuously to 90° on a suitable substrate. The rolling-off properties of the drop and the possible running of color in contact with printed areas are evaluated.

The papers are printed by means of the HP 550 C in three-color and four-color printing mode.

The hydrophobic silicas according to examples 1, 2, 3, 6, 7 and 8 are known from the document EP 0 798 348 B1, the entire contents of which are hereby incorporated by reference.

The hydrophobic silicas according to examples 1, 3 and 7 and the hydrophobic silicas according to example 5 are commercial products which are described in the brochure "Fällungskieselsäuren und Silikate {Precipitated Silicas and Silicates}" of Degussa-Hüls AG, Business Unit Filler Systems and Pigments, the entire contents of which are hereby incorporated by reference.

Table 1

	Sipernat C 600 Ex. 1	Sipernat D 17 Ex. 5	Ex. 6	Ex. 2	Sipernat C 630 Ex. 3	Ex. 4	Sipernat C 630 / MOX 170 Ex. 7	MOX 170 Ex. 8	Standard recipe Sip. 310/ MOX 170
Batch no.	# 237	# 235	# 241	# 229	# 238	# 231	# 243	# 242	# 218
Solids content in %	12.5	15	10	15	10	7	12.5	20	15
pH	6	5	5.5	5.5	5.5	4.5	5.5	6	5.5
Viscosity, Brookfield after 7 days in mPa s									
after stirring up	5 rpm 10 rpm 20 rpm 50 rpm 100 rpm	1720 1180 890 210 180	280 200 145 110 115	240 220 190 175 180	600 410 200 190 135	15120 6640 2820 1385 1110	1360 830 530 330 240	550 500 490 470 460	360 420 385 300 250
Surface area (m ² /g)	160	100	200	100	160	170	650/170	600	650/170
DBP uptake (g/100g)	260	225	270	250	250	-	-	260	-
Particle size (μm/nm)	4.5 μm	10 μm	5 μm	10 μm	7 μm	12 nm	7 μm/15 nm	8	5.5 μm/15 nm
C content (%)	0.9	2.1	1.0	1.0	0.5	1.2-2.2	-	1.0	0.05
Coating weight in g/m ²	10.0	13	11	12	10	19	12	15	11
Adhesion and smoothness of the coating	adhesion poor, medium- rough	good, smooth	medium, smooth	good, smooth	medium, rough	good, rough, cloudy	scarcely any medium	very good, rough	good, smooth-medium

1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 2608 2609 2610 2611 2612 2613 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623 2624 2625 2626 2627 2628 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648 2649 2650 2651 2652 2653 2654 2655 2656 2657 2658 2659 2660 2661 2662 2663 2664 2665 2666 2667 2668 2669 2670 2671 2672 2673 2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 2688 2689 2690 2691 2692 2693 2694 2695 2696 2697 2698 2699 2700 2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712 2713 2714 2715 2716 2717 2718 2719 2720 2721 2722 2723 2724 2725 2726 2727 2728 2729 2730 2731 2732 2733 2734 2735 2736 2737 2738 2739 2740 2741 2742 2743 2744 2745 2746 2747 2748 2749 2750 2751 2752 2753 2754 2755 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2766 2767 2768 2769 2770 2771 2772 2773 2774 2775 2776 2777 2778 2779 2780 2781 2782 2783 2784 2785 2786 2787 2788 2789 2790 2791 2792 2793 2794 2795 2796 2797 2798 2799 2800 2801 2802 2803 2804 2805 2806 2807 2

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Table 2

Test for determination of the absorption properties		Sipernat C 600 Ex. 1	Sipernat D 17 Ex. 5	Ex. 6	Ex. 2	Sipernat C 630 Ex. 3	Ex. 4	Sipernat C 630 / MOX 1710 Ex. 7	MOX 170 Ex. 8	Standard recipe Sip. 310/ MOX 170
Batch no.		# 237	# 235	# 241	# 229	# 238	# 231	# 243	# 242	# 218
Diameter of dried drop - Test A	in mm K CMY	4 8	8 8	8 7	9 8	8 8	10 6	6 8	5 8	12 9
Length of drawn-out drop - Test C	(longitudinal) in mm K CMY	41 26	8 10	10 40	24 30	>240 42	15 15	100 60	>250 40	5 14
Drying properties/ appearance	Evaluation K CMY	4- 3+	3- 3-	2 2	2 2-	6- 2-	4 2-	3- 3-	4 4	2 3
Color intensity	Evaluation	II	II	II	II-	II-	II			II
Penetration Properties	Evaluation	-	++	0	0-	0-	0+	0	0	-

Black = K

20 Magenta / yellow / cyan = CMY

The clear increase in the (drawn-out) drop length (test C) indicates the increase in the hydrophobic properties of the surface.

Table 3

Appearance of the drop and drying properties		Color intensity		Penetration properties	
1	drop is uniformly absorbed immediately, even edges	I	strong, luminously clear color shades	+	no penetration through to the reverse of the paper
2	drop is uniformly absorbed immediately, frayed edges, slight blotting paper effect	II	strong, clear color shades	+	very slight penetration through to the reverse of the paper
3	drop initially remains on the paper in bead form, dries slowly, even edges	III	strong color shades with a slightly matted effect	0	moderated penetration through to the reverse of the paper
4	drop initially remains on the paper in bead form, dries slowly, frayed edges, slight blotting paper effect	IV	matt color shades	-	more severe penetration through to the reverse of the paper, reverse still dry
5	drop is absorbed uniformly, edges more severely frayed, blotting paper effect	V	very matt color shades, hardly any color intensity	-	complete penetration through to the reverse of the paper, reverse damp to soaked through
6	drop is absorbed unevenly, edges more severely frayed, severe running of the ink in all levels				

the following parameters are additionally measured:				
A	● Diameter of the dried drop in mm	B	● Time taken for drying in sec - the shorter the time, the better the drying	● Length of the drawn-out drop in mm after an action time of 1' (predrying) - the shorter the value in mm, the better the drying

Table 4

Evaluation of the printing test by means of the HP 550 C

Four-color printing									
	Sipernat C 600 Ex. 1	Sipernat D 17 Ex. 5	Ex. 6	Ex. 2	Sipernat C 630 Ex. 3	Ex. 4	Sipernat C 630 / MOX 170 Ex. 7	MOX 170 Ex. 8	Standard recipe Sip. 310/ MOX 170
Batch no.	# 237	# 235	# 241	# 229	# 238	# 231	# 243	# 242	# 218
Color intensity	1-	3-	3	1	2	1-	2	4	2
	2	2	2-	1	2-	1-	2	3	2
Point sharpness	2+	2+	2	1-	2+	2+	2	3	3
Transitions	1-	1-	2	1-	2+	2+	1	2-	1
Point sharpness	2	2	2-	1	2-	1-	2	3	2
	1-	2-	2	1-	2-	1-	2	3	3-
Half-shade	1	2-	2	1-	1	1	1	2-	2+
Total evaluation	11.25	15.75	15.5	9	14	10.5	12	21	16.75

Table 5

Three-color printing									
	Sipernat C 600 Ex. 1	Sipernat D 17 Ex. 5	Ex. 6 Ex. 2	Sipernat C 630 Ex. 3	Ex. 4 Ex. 7	Standard recipe Sip. 310/ MOX 170	Sipernat C 630 / MOX 170 Ex. 7	MOX 170 Ex. 8	
Batch no.	# 237	# 235	# 241	# 229	# 238	# 231	# 218	# 243	# 242
Color intensity	1-	1	2+	1	2-	2	3	2-	3
	2-	2+	2-	2	2-	2	2	2-	3
Point sharpness	2+	2	2	1-	1-	1	1-	2	2
Transitions	1-	2-	1-	1-	1	1	1	1	1
Point sharpness	2-	2+	2-	2	2	2	3	2-	3
	2	2+	2-	2+	2+	2	2	2+	2
Half-shade	3+	4	1-	4	1	1	2	1	1
Total evaluation	14.5	14.75	14.25	13.25	12.25	11	15.5	13.25	15

Table 6: Evaluation table for four-color printing (black and color)

Color intensity		Point sharpness		Transitions		Point sharpness		Half-tone print	
magenta/ yellow/cyan	black	black in color	black in color	color in color	black print	black contours	color intensity/contours		
1+	luminous, strongly intensive	1	full color shade, strongly intensive	1	clear separation, very good sharpness	1	clear separation, very good sharpness	1	grey shade clear to the optimum, fine lines demarcated
1	matt, strongly intensive	2	slight running, still good to moderate sharpness	2	slight running, still good demarcation	2	slight running, still good to moderate sharpness	2	grey shade blurred, fine lines demarcated
2	matt, pale	3	running, somewhat blurred	3	running, somewhat blurred	3	running, somewhat blurred	3	grey shade clear to the optimum, fine lines blurred
3+	luminous, spotted	4	washed-out pale color shade	4	washed-out pale color shade	4	bleeding, running, blurred	4	grey shade blurred, fine lines blurred
3	matt, spotted	5	severe running, scarcely readable	5	severe running	5	severe running, scarcely readable	5	grey shade dark to black, fine lines blurred

Table 7: Evaluation table for three-color printing (all colored)

Color intensity		Point sharpness		Transitions		Point sharpness		Half-tone print	
magenta/ yellow/cyan	black	black in color		color in color		black print		black contours	
1+ luminous, strongly intensive	1 full black color shade, strongly intensive	1 clear separation, very good to good sharpness	1 clear separation, clearly demarcated	1 clear separation, clearly demarcated	1 full black color shade, strongly intensive	1 clear separation, very good to good sharpness	1 grey shade clear to the optimum, fine lines demarcated	1	
1 matt, strongly intensive		2 slight running, still good demarcation	2 slight running, still good demarcation	2 slight running, still good demarcation		2 slight running, still good to moderate sharpness	2 grey shade blurred, fine lines demarcated	2	
2 matt, pale	3 washed-out, pale black color shade		3 running, somewhat blurred	3 running, somewhat blurred	3 washed-out, pale, black color shade		3 grey shade clear to the optimum, fine lines blurred	3	

3+	luminous, spotted	4	full olive-colored color shade, strongly intensive	4	bleeding, running, blurred		4	full olive-colored color shade, strongly intensive	4	bleeding, running, blurred	4	grey shade blurred, fine lines blurred
3	matt, spotted			5	severe running, scarcely readable		5		5	severe running, scarcely readable	5	grey shade olive, fine lines demarcated
3-	strongly intensive, marbled	6	washed-out, pale, olive-colored color shade	6	very severe running, not sharp, unreadable		6	washed-out, pale olive-colored color shade	6	very severe running in the area, not sharp, unreadable	6	grey shade olive, fine lines blurred
4	matt, marbled										6	grey shade colored through green, fine lines scarcely detectable
5	pale, marbled											

Table 8

Testing of the wettability of the printed and non-printed paper surfaces with water

	Sipernat C 600 Ex. 1 # 237	Sipernat D 17 Ex. 5 # 235	Ex. 6 # 241	Ex. 2 # 229	Sipernat C 630 Ex. 3 # 238	Ex. 4 # 231	Sipernat C 630 / MOX 170 Ex. 7 # 243	Ex. 8 # 242	Standard recipe Sip. 310/ MOX 170 # 218
Paper properties	very hydrophobic, water is not absorbed in	very hydrophobic, water is not absorbed in	very hydrophobic, water is absorbed in immediately	hydrophobic, water is not absorbed in	hydrophobic, water is not absorbed in	slightly hydrophobic, water is absorbed in	hydrophobic, water is not absorbed in	hydrophobic, water is not absorbed in	not hydrophobic, water is absorbed in
Drop flow properties	drop rolls off	drop rolls off	drop sticks	drop remains/ sticks on the paper	drop rolls off	drop remains/ sticks on the paper	drop sticks	drop rolls off	drop runs, is absorbed in
Color/ contour properties	colors bleed only slightly, contours remain very clear	colors bleed only slightly, contours remain	colors bleed only slightly, contours remain	colors bleed only slightly, contours remain very clear	colors bleed only slightly, contours remain	colors bleed only slightly, contours remain	colors bleed slightly, contours remain	colors bleed slightly, contours remain	colors bleed more severely, contours remain

No additives or co-binders which have a more favorable effect on the water resistance are added to the coatings of the examples.

A good water resistance can be achieved by the use according to the invention of the silicas.

5 This effect can be optimized more by addition of further additives and binders.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

10 This application is based on European patent application EP 00107733.8, filed April 11, 2000, the entire contents of which are hereby incorporated by reference, the same as if set forth at length.

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